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Issued February 1952

Publication 871

# Spring and Winter Wheat for Eastern Canada

by

**J. G. C. FRASER & A. G. O. WHITESIDE**

**CANADA DEPARTMENT OF AGRICULTURE  
OTTAWA, CANADA**

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# **Spring and Winter Wheat**

**for**

## **Eastern Canada**

**by**

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## SPRING AND WINTER WHEAT FOR EASTERN CANADA

Wheat is one of the oldest cereals cultivated by man; historical records indicate that it was grown by the early Egyptians in 6000 B.C.

In North America the first settlers found the Indians growing maize or Indian corn and harvesting wild rice from the swampy margins of rivers and lakes. Wheat, however, was an introduced crop and was one of the first cereals that the early settlers tried to grow.

The first record of wheat growing in North America was in 1605, at the French Settlement of Port Royal in what is now the province of Nova Scotia. Champlain wrote in his diary that fine wheat was cut in Quebec City in 1616 for transport to France, while Father Le Jeune, an early Jesuit priest, records good crops in the colony in 1636.

The census of 1861 shows that wheat was one of the two most important field crops grown in Upper and Lower Canada.

	Crop Acreage in 1861		
	Spring Wheat	Winter Wheat	Oats
Upper Canada.....	951,637	434,739	678,337
Lower Canada.....	239,289	5,480	955,553
Total.....	1,190,926	440,219	1,633,890

It will be observed from Fig. 1 that in the four decades following 1861, the total wheat acreage in Eastern Canada increased only slightly, reaching a peak in 1901. With the opening of the Western Prairies to Agriculture, the wheat

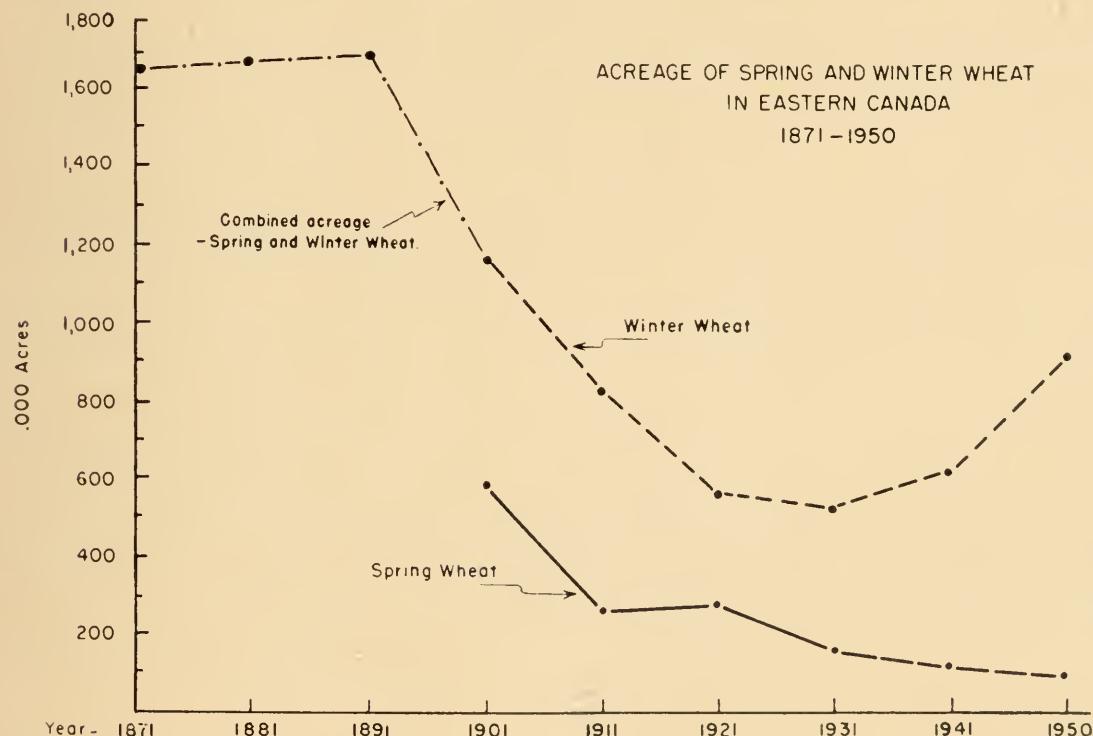


Fig. 1—Acreage of spring and winter wheat in Eastern Canada 1871-1950.

acreage in the East fell off rapidly. The decline was very noticeable in the case of spring wheat, so that by 1950 the acreage was down to slightly over 100,000 acres. The winter wheat acreage, however, declined more slowly, started to rise again in 1931, and now occupies over 900,000 acres, most of which is located in Ontario.

In table 1, the production of spring and winter wheat in bushels as recorded in the Quarterly Bulletin of Agricultural Statistics, Vol. 44, No. 1, Dominion Bureau of Statistics, is given for 1950. Winter wheat is recorded for Ontario only, although it is known that small acreages are grown in other parts of Eastern Canada. Spring wheat is grown in every province but the total production is not large.

TABLE 1—PRODUCTION OF WHEAT IN EASTERN CANADA, 1950

	Winter Wheat bushels	Spring Wheat bushels
Prince Edward Island.....	—	187,000
New Brunswick.....	—	90,000
Nova Scotia.....	—	45,000
Quebec.....	—	691,000
Ontario.....	30,067,000	1,166,000
Total.....	30,067,000	2,179,000

### Adaptation

#### Spring Wheat

Spring wheat is widely adapted in Eastern Canada and good crops can be produced in every province. The acreage is small, however, because it is produced mainly for feed. This is because the quality of the flour from wheat grown in the East is generally not so satisfactory for making high quality bread as that grown in the West.

#### Winter Wheat

The winter wheat crop is less widely adapted in Eastern Canada than spring wheat because of the hazards of winter killing. When it can be grown successfully, it will outyield spring wheat by a substantial margin. Winter wheat growing is confined mainly to Ontario and is concentrated in the southern, western, and central parts of that province. Elsewhere the formation of ice in the fields during the winter or early spring often causes winter killing irrespective of the winter hardiness of the variety. This does not mean that good crops of winter wheat cannot be grown in other areas. However, in districts where mid-winter thaws and rains that are often followed by sub-zero weather and the formation of ice sheets can be expected, fields with good natural drainage should be selected. In Fig. 2, winter wheat plants killed by ice and surface water in a poorly drained field are shown. Where good snow cover persists throughout the winter, the winter wheat crop will usually survive and give high yields.

### Utilization

Wheat grown in Eastern Canada is largely used as a feed for livestock and poultry. Experimental evidence and practical experience indicate that this grain may be a satisfactory and economical feed for livestock when mixed with other feeds, and in the case of poultry, wheat is the stable feed grain and usually makes



Fig. 2—Poorly drained fields should be avoided for winter wheat. This photograph shows winter wheat plants killed by ice and surface water.

up 50 per cent or more of all poultry feeds. Publication 856, "Wheat As A Feed For Livestock And Poultry", giving further information on this subject, is available from Information Service, Department of Agriculture, Ottawa.

Upwards of 30 per cent of the winter wheat crop grown in Ontario is used for milling into flour suitable for the production of biscuits, cakes, pastries, or crackers. The climate and soil in this part of Canada are unique for the production of the best type of soft wheat for these purposes. The best varieties are those that have soft kernels and produce flour low in protein and weak in gluten strength.

### **Growing The Wheat Crop**

Wheat requires a well prepared seed-bed and does not thrive under adverse conditions so well as oats. In fact wheat yields are likely to be disappointing if soil fertility is low. Clays and clay loams are perhaps the most productive and if well drained will generally give better yields and quality than the other types of soil. The seed-bed should be free from weed growth, the soil well cultivated, with the earth loose on top and fairly compact beneath.

#### **Ploughing**

For spring wheat it is necessary in most localities to plough the land during the preceding fall to have the soil ready for seeding as early in the spring as possible. To ensure an early start and to hasten maturity it is preferable to run the

risk of damage from spring frosts. For winter wheat the time of ploughing will depend on its place in the rotation. The general practice when following clover or hay is to plough after haying has been completed and work the land thoroughly in time to seed early in September.

It has been found that ploughing less than four inches or more than seven inches has not been desirable but no specific rules can be laid down. The depth will vary with the character of the soil.

#### **Preparation of the Land**

In the preparation of the land for spring wheat, well set up furrows will assist the action of the winter frosts. As soon as the land is dry enough in the spring to support a team or tractor, a light disking, followed by the harrow both ways, will usually put the soil in condition for seeding. Following hoed crops, a light ploughing or ribbing will provide sufficient fall preparation of the land. This is followed in the spring by disking and harrowing.

Adequate preparation of the soil for winter wheat is important if the best returns are to be obtained from this crop. If sod is to be ploughed down, this should be done several weeks before seeding and the land thoroughly cultivated three or four times. Winter wheat may follow sod, intertilled crops, or spring grain.

#### **Seeding**

The depth of seeding will depend on the condition and type of soil at the time of seeding, but from one to three inches is generally ample under eastern conditions.

The time of seeding is important with both the spring and winter crops as the resulting yields can be greatly influenced by this factor. As already pointed out, spring wheat should be planted as early in the spring as seeding conditions permit. With fall-sown wheat, it is preferable to seed early in September. It is not advisable to sow later than the third week, except in those areas where long, open fall weather can be expected or where the presence of Hessian fly (Fig. 3), necessitates later seeding in order to partially escape damage from this pest. As shown in Fig. 4, it is important to seed early enough that healthy well developed plants are produced before winter sets in.

Wheat is now sown almost entirely with a seed drill and very little is "broadcast". The rate of seeding depends on the area and local practices. Wheat is generally sown at the rate of six pecks or ninety pounds to the acre, sometimes as low as five pecks, and not infrequently as high as eight pecks especially in the case of winter wheat. Late-sown grains are sometimes seeded at the higher rate to hasten maturity.

#### **Fertilizing**

Wheat responds very well to fertilizers. Manure may be spread on the soil before ploughing, in which case an application of 10 tons per acre will reduce the amount of commercial fertilizer required. If manure is limited the rate of application of commercial fertilizer should be increased. A soil analysis will indicate the proper quantities to use. When manure is used or when a good stand of clover or alfalfa is being turned down superphosphate (20 per cent) at 150 to 200 lb. per acre may be applied. Ordinarily an application of 300 lb. of 2-12-6 or its equivalent per acre is recommended.



(O.A.C. photo)

FIG. 3—Puparia (flaxseed) of the Hessian fly, *Phytophaga destructor* (Say).

### Preparation of the Seed

Prior to planting, the seed should be thoroughly cleaned to remove weed seeds and any broken, shrivelled, and diseased kernels. Treatment with mercurial dust is necessary to control bunt or stinking smut, and to lessen the damage caused by seedling blights. If wireworms are present, the use of benzine-hexachloride (B.H.C.) is helpful in controlling this pest. Further information on this subject is given in "Wireworms", Processed Publication No. 87, Division of Entomology, Science Service, Department of Agriculture, Ottawa.

### Harvesting

Harvesting should take place when the greatest quantity of grain can be harvested from the crop. It is easy to tell when the crop is ripe by pressing a kernel here and there in the field with the thumb nail. When a fair pressure only slightly dents the kernel, the grain is considered to be ripe. In Eastern Canada, harvesting is still largely done with a four-to-seven-foot binder, although the combine is becoming more popular because of the saving in time and labour which it effects. Varieties that tend to shatter must be harvested earlier than those that resist shattering. If the combine is used, it is advisable to leave the crop standing till it is dead ripe before cutting. With a binder, the crop may be cut slightly before the dead ripe stage as the crop will mature in the stook. The stooks of eight to ten sheaves should be so constructed that they will stand up against the wind, resist rain, and dry out readily.

### Wheat As A Nurse Crop

Spring wheat makes a satisfactory nurse crop as the stand is rarely too heavy to prevent the young legumes and grasses from getting sufficient sunlight for their development. Winter wheat may be seeded down but it is preferable to delay



FIG. 4—Winter wheat plants should be well developed before winter sets in.

seeding the mixture until early spring when it may be broadcast on the fields just as the snow is leaving the ground. As a nurse crop wheat is generally superior to a normal crop of oats and equal to barley.

Seeding spring wheat with other grains is not recommended except where its strong straw may assist in holding up the mixed crop.

### Zonation of Wheats in Eastern Canada

Wheat growing is distributed in Eastern Canada chiefly in the seven zones shown in table 2. This table shows the reported acreages for both spring and winter wheat. Soft white winter wheat for milling into pastry flour is produced in Zones 2, 3 and 4.

TABLE 2—ACREAGE OF SPRING AND WINTER WHEAT IN 7 ZONES IN EASTERN CANADA

Zone	Spring Wheat		Winter Wheat
	*Acres	*Acres	
1. Northern Ontario.....	7,500	3,100	
2. Southern Ontario.....	11,500	421,300	
3. Western Ontario.....	14,900	283,700	
4. Central Ontario.....	7,000	196,600	
5. Eastern Ontario.....	14,100	23,000	
6. Quebec.....	32,900	—	
7. Maritimes.....	12,300	—	

\* 1950 figures. The Dominion Bureau of Statistics, Department of Trade and Commerce, and The Statistics Branch, The Ontario Department of Agriculture.

### Recommended Varieties

Several varieties of spring and winter wheat are recommended for growing in Eastern Canada. These are shown in tabular form in table 3 and are described in detail below. All the spring wheat varieties have red grain except Cascade, which is a semi-hard white wheat and Mindum which is an amber durum wheat. Four of the winter wheat varieties are white wheats and the other two have red grain. All the varieties are licensed for sale in Canada. In Fig. 5, 6 and 7 the various steps in the production of new varieties are shown.

TABLE 3—RECOMMENDED VARIETIES OF SPRING AND WINTER WHEAT BY ZONES

Zone	Spring Wheat	Winter Wheat
1.	Acadia, Regent, Saunders	Rideau
2.	Acadia, Cascade	Cornell 595, Dawson's Golden Chaff, Dawbul, Fairfield*
3.	Acadia, Cascade	Cornell 595, Dawson's Golden Chaff, Dawbul
4.	Acadia, Cascade, Coronation II	Cornell 595, Dawson's Golden Chaff
5.	Acadia, Cascade, Coronation II	Rideau, Cornell 595, Dawson's Golden Chaff
6.	Acadia, Cascade, Coronation II	Kharkov 22 M.C., Rideau
7.	Acadia, Cascade, Regent, Coronation II, Garnet, Huron	Rideau, Kharkov 22 M.C.

Varieties in order of preference.

\* Kent County.



FIG. 5—First step in the production of a new variety is hybridization carried out by crossing.

### Varieties of Spring Wheat

#### Hard Red Spring

*Acadia*—Acadia was selected at Indian Head, Sask., in 1937 from a cross made in 1934 at Ottawa between Canus  $\times$  (Pentad  $\times$  Marquis). It was licensed in 1951 and will be available to farmers in Eastern Canada by 1952. This variety is mid-season, strong strawed, high yielding and moderately resistant to stem rust and leaf rust, bunt, black chaff, and some forms of root-rot. It is semi-resistant to loose smut. The head is bearded with smooth white chaff.

*Coronation II*—Coronation II arose from a selection made at Ottawa from a Pentad and Marquis hybrid produced at the Laboratory of Cereal Breeding, Winnipeg. The Ottawa selection is easier to thresh than the original, which was licensed in 1937. The selection was accepted for registration in 1943. Coronation II is a strong strawed, bearded, moderate yielding variety with white smooth chaff. It is resistant to stem rust but moderately susceptible to some new races of leaf rust. This variety is widely distributed in zones 5, 6, and 7.

*Garnet*—This is one of the earliest hard red spring wheats grown in Canada. It originated at Ottawa from a Preston A  $\times$  Riga M cross made in 1905. It was licensed in 1925 and distributed at once to Canadian farmers. Certain deficiencies in quality caused this variety to be placed in special C. W. Garnet grades in 1935. It was accepted for registration the following year. It is 5 to 7 days earlier than Marquis and high yielding, but is susceptible to leaf rust, stem rust, bunt, and loose smut. Its high yield and earliness make it a popular variety in districts where earliness is a factor in crop production.

*Huron*—This is a bearded, red chaffed wheat with good straw and fair to good yielding ability when conditions are favourable. Its susceptibility to leaf rust, stem rust, and loose smut has reduced its popularity and it is now being replaced by Coronation II and Cascade wheat in Quebec and the Maritime Provinces.

*Regent*—Regent was developed at the Laboratory of Cereal Breeding, Winnipeg, Man., from an H-44  $\times$  Reward cross made in 1926. Regent was licensed in 1939 and accepted for registration in the same year. This variety is beardless with short apical awns, smooth white chaff, and straw of good strength. It is a medium early maturing variety with fair yielding ability in zone 1 where it is one of the leading varieties. It is resistant to stem rust and bunt, semi-resistant to loose smut, and moderately susceptible to leaf rust. It is equal to Marquis in quality.

*Saunders*—Saunders is an early maturing variety, resistant to stem rust and loose smut, and developed by the Cereal Division at Ottawa from a Thatcher  $\times$  C-26. -44.7 cross made in 1938. It was licensed in 1947 and accepted for registration in the same year. This variety has excellent quality but has not yielded so well as Acadia or Cascade. The head of Saunders has only a few apical awns, smooth white chaff, and strong straw. It is moderately susceptible to leaf rust.

#### **Semi-hard White Spring Wheat**

*Cascade*—Cascade was developed by the Cereal Division, Central Experimental Farm, Ottawa, from the cross Quality A  $\times$  [(Pacific Blue Stem  $\times$  C-26-59.2D)]  $\times$  Onas made in 1936. This variety was licensed in 1947 and accepted for registration the same year. Cascade is a semi-hard white wheat with beardless, white, smooth chaffed heads. The yields are good in all areas where it has been tested and it matures in mid-season with such varieties as Marquis and Huron. It is resistant to stem rust and black chaff, semi-resistant to loose smut and powdery mildew but moderately susceptible to leaf rust and bunt. Cascade is taking over the greater part of the acreage formerly occupied by Huron wheat.

#### **Durum Wheat**

This type of wheat was extensively grown some years ago, but the introduction of rust-resistant hard red wheats has now greatly reduced the acreage of durum wheat in Eastern Canada. Goose was the variety commonly grown but Mindum is the principal durum variety at the present time. Chick feeds, patented breakfast foods, and macaroni are the main uses for durum wheat.



FIG. 6—New varieties are thoroughly tested in small plots.



FIG. 7—Increase plot of a new variety.

*Mindum*—This variety arose from a selection made by the University of Minnesota from Hedgerow in 1896. The stock grown in Canada, comes from a selection made by W. T. G. Wiener of the Manitoba Agriculture College in 1924. *Mindum* is resistant to stem and leaf rust and moderately resistant to loose smut. It yields well in zone 4 in some seasons.

### Varieties of Winter Wheat

#### Soft White Winter

*Cornell 595*—This variety was developed at Cornell University, Ithaca, N.Y., from a series of crosses involving Honor, Forward, and Nured (Honor identical with Dawson's Golden Chaff). It was licensed for sale in Canada in 1946 and distributed to farmers in Ontario. Registered crops were produced in 1950. It is a high yielding, soft white winter wheat, with winter hardiness similar to Dawson's. It is distinguished from Dawson's by its more lax head, more nodding head at the ripening stage, and purple straw when nearing maturity. It is resistant to the loose smut commonly found in Dawson's but is susceptible to bunt or stinking smut, leaf rust, and stem rust. It is high in milling quality for the production of pastry flours. *Cornell 595* is widely adapted to the main winter wheat areas of Ontario where it is now the leading variety.

*Dawbul*—*Dawbul* originated at the Ontario Agricultural College from the cross Dawson's Golden Chaff  $\times$  Bulgarian. It was licensed for sale in 1948. Apart from a somewhat coarser head than Dawson's it is similar in appearance. *Dawbul* is resistant to loose smut but susceptible to bunt, and to leaf and stem rust. It is a high yielding, strong strawed, soft white winter wheat which is becoming popular in some counties in southern Ontario.

*Dawson's Golden Chaff*—Dawson's came from a single plant selected from a field of Clawson wheat in 1881 by Robert Dawson, Paris, Ontario. It was dis-

tributed by the Ontario Agricultural College and has been a leading variety in Ontario for over 50 years. It is widely adapted to the main winter wheat areas of Ontario, and registered seed stocks have been produced for many years. Loose smut has been a troublesome disease in Dawson's Golden Chaff and much of the former acreage devoted to this variety has been replaced by the more resistant Cornell 595. Dawson's is a high quality soft white winter wheat for the pastry flour trade, as well as a strong strawed, high yielding variety in the field.

*Rideau*—Rideau was developed by the Cereal Division, Ottawa, from the cross Kharkov 22 M.C.  $\times$  Dawson's Golden Chaff. It was licensed and introduced to farmers in Eastern Ontario in 1941, and was accepted for registration in 1946. It is definitely more winter hardy than Dawson's or Cornell 595 and is recommended for those areas where this extra hardiness is required. The kernels are white but not so soft as those of Dawson's and the chaff is white. It is not so satisfactory for milling into pastry flour as Dawson's or Cornell 595.

#### Red Winter

*Fairfield*—Fairfield originated from the cross Purkof  $\times$  Fulhio made in 1926 at Purdue University, Indiana. It was licensed for sale in Canada in 1950. It is a soft red winter wheat that has yielded well in the Kent county area of Southern Ontario. It is a beardless variety, has white chaff, and is resistant to loose smut.

*Kharkov 22 M.C.*—This variety originated as a single plant selection made at Macdonald College in 1912 from Kharkov, a variety of Russian origin introduced into the United States in 1900. It is noted for its winter hardiness but is grown only to a limited extent in Eastern Canada. It is a bearded variety and has white chaff. The straw is inclined to be weak.

### Diseases of Wheat and Their Control

Several fungus diseases are present each year in the wheat crop. Some of these may be controlled by seed treatment and others by the choice of variety. Good cultural practices such as suitable rotations, good soil fertility and soil preparation which contribute to the growing of strong vigorous plants will lessen the damage from certain diseases. The severity of the fungus diseases varies in different localities and in different seasons. A description of some of the more common diseases found in wheat crops in Eastern Canada is given below.

#### Leaf Rust (*Puccinia triticina* Eriks)

Leaf rust is probably more widespread than any other disease of wheat in Eastern Canada. This fungus is first noticed on the leaves as small circular orange coloured pustules. These pustules are circular in shape, smoother on the surface and light reddish orange in colour in contrast with the pustules of stem rust, (*Puccinia tritici*), which are more elongated, have rougher surfaces and are dark red in colour.

Infection is spread from plant to plant by the tiny rust spores which are wind borne. Initial infection takes place from spores, either blown northward into Canada or from overwintering spores. As these spores infect the leaves, mycelium is produced which feeds in the leaf tissues and after a week to ten days produces the characteristic orange specks on the leaves. These specks contain thousands of new spores which are spread to leaves of other plants to begin a new cycle.

Leaf rust does its greatest damage when it appears early and when it infects not only the leaf blades but the leaf sheaths as well. Leaf rust will cause the wheat to ripen prematurely and produce grain of lower bushel weight and smaller kernels, and may reduce yields by as much as 20 per cent.

The severity of leaf rust depends largely on the weather as warm moist weather favours its development. The only control measure is the use of varieties resistant to leaf rust. Like most fungi there are a number of biological races or varieties of leaf rust and while some varieties of wheat may be resistant to some races they may be susceptible to others.

#### **Stem Rust (*Puccinia graminis tritici* Eriks, and Henn.)**

Stem rust usually appears later than leaf rust as it requires a little higher temperature to thrive best. It attacks the stems and leaf sheaths and in severe epidemics will be found on the leaf blades and on the heads. The pustules are reddish brown in colour, usually elongated, and they always rupture the plant epidermis.

Stem rust first infects the wheat plant from spores coming from the barberry bushes or by spores from other wheat plants carried long distances by the wind. They produce a network of mycelium in the wheat tissue and later develop the red rust stage. The spores from these pustules are carried from plant to plant and cause a secondary infection and these in turn may produce further infections. In advanced stages the wheat plants begin to dry up. At the end of the red stage the life cycle of the rust changes into the winter spore stage which appears as black lesions on the straw.

Stem rust can be very destructive as it feeds in the stems and cuts off much of the plant food which would normally be used to develop the seed. Widespread epidemics of stem rust do not usually occur in Ontario winter wheat as this crop is generally well advanced before stem rust has developed to epidemic proportions, but occasionally it will account for some loss. Stem rust can be more destructive to spring wheat than to winter wheat but since most of the recommended varieties are resistant to this disease, it should not be a problem in Eastern Canada.

#### **Root-rots**

Common root-rots are caused chiefly by two soil fungi known as *Helminthosporium sativum* and *Fusarium culmorum*. In the field, small patches of prematurely ripened grain with the grain shrivelled in the head are characteristic effects of these diseases. While the plants are not easily pulled up, much of the root system has been destroyed. A close examination of the crown and the base of the straw will show a rotted condition and even the feathery mycelium of the fungus may be seen. Infection may be caused by spores carried on the seed, but usually they are already present in the soil. Treating the seed with mercuric compounds, proper rotations in which wheat does not follow wheat, and good fertility practices reduce the damage from this disease. Winter wheat plants weakened by the winter or growing in excessively damp fields in the spring will often be considerably damaged by root-rot.

Take-all root-rot caused by *Ophiobolus graminis*, does not appear to be a serious disease of wheat in Eastern Canada. Where it occurs it can be very destructive as the roots are more extensively damaged than with common root-rot. The stems will fall over in severe cases and the grain will be severely shrunken. The crop rotations usually practised in the East prevent the spread of this destructive disease.

#### **Loose Smut (*Ustilago tritici* (Pars) Rostr.)**

Loose smut of wheat may be recognized by the mass of black spores which appear at heading to blossoming time of the wheat plant as shown in Fig. 8. The loose spore mass replaces the floral parts of the head and after a few days will be blown away by the wind leaving only the framework of the wheat head. Loose



FIG. 8—Loose smut in winter wheat.

smut is carried over from season to season by infection which takes place from these black spores that reach healthy flowers of other wheat heads. The mycelium or vegetative part of the loose smut grows along with the wheat kernel in the embryo or germ. In this way it is carried over in the seed to grow up with the new plant and to produce the black spore mass the following year.

The only method of control is the hot-water treatment of the seed or the use of resistant varieties. A useful reference on the subject of seed treatment may be had by writing to the Information Service, Department of Agriculture, Ottawa, for Publication 834 "Treatment of Cereal Seed".

**Bunt or Stinking Smut (*Tilletia caries* (DC) Tul. and *Tilletia foetida* (Walbi) Liro)**

Bunt or stinking smut can be readily distinguished from loose smut and should not be confused with it. The symptoms usually show sometime after the plant has headed, although a stunting of the plant may occur before this time. It may also be recognized early by a bluish green cast to the leaves as compared with the green of healthy plants. As the plant develops the smut balls occur in place of the seed and these are covered by the skin-like covering of the seed ovary. Some of these rounded balls will be broken up in threshing and the masses of black spores liberated will blacken healthy seed. Other smut balls will remain unbroken. A characteristic odour which is easily recognized will be given off.

Bunt will reduce yield, cause difficulties in threshing, and lower the quality of the wheat. The disease can be controlled readily by seed treatment with mercurial compounds.

**Scab** (*Gibberella and Fusarium Spp.*)

This disease is easily recognized in the heads although it also occurs as a seedling blight, root-rot and head blight. The infected spikelets first appear water-soaked, followed by loss of chlorophyll and a final bleached straw colour. In warm humid weather the heads will often show a salmon-pink cast. The kernels will be shrivelled and scabby in appearance, and range in colour from white, pink, to light brown.

The disease is seed-borne as well as being spread from decaying crop residues. Crop rotation, sanitation, soil preparation, and seed treatment with mercurial compounds are effective controls. The thin scabbed kernels should be removed from the seed wheat to be sown.

**Powdery Mildew** (*Erysiphe graminis tritici*, El. Marchal)

The characteristic symptom of powdery mildew is the gray powdery spots scattered on or almost completely covering the leaf blade, with the yellowing, browning and gradual drying out of the leaf. It is almost always found on the lower leaves of the wheat plant except on those varieties that are resistant. Where the growth is heavy and where lodging takes place early in the season considerable mildew infection may be found.

There is no effective control in the field except the use of resistant varieties. Heavy infections will reduce yield but the damage to wheat is not so great as to barley.

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